EXTREME
fiber sensing

strain sensing
thermal mapping
pressure sensing
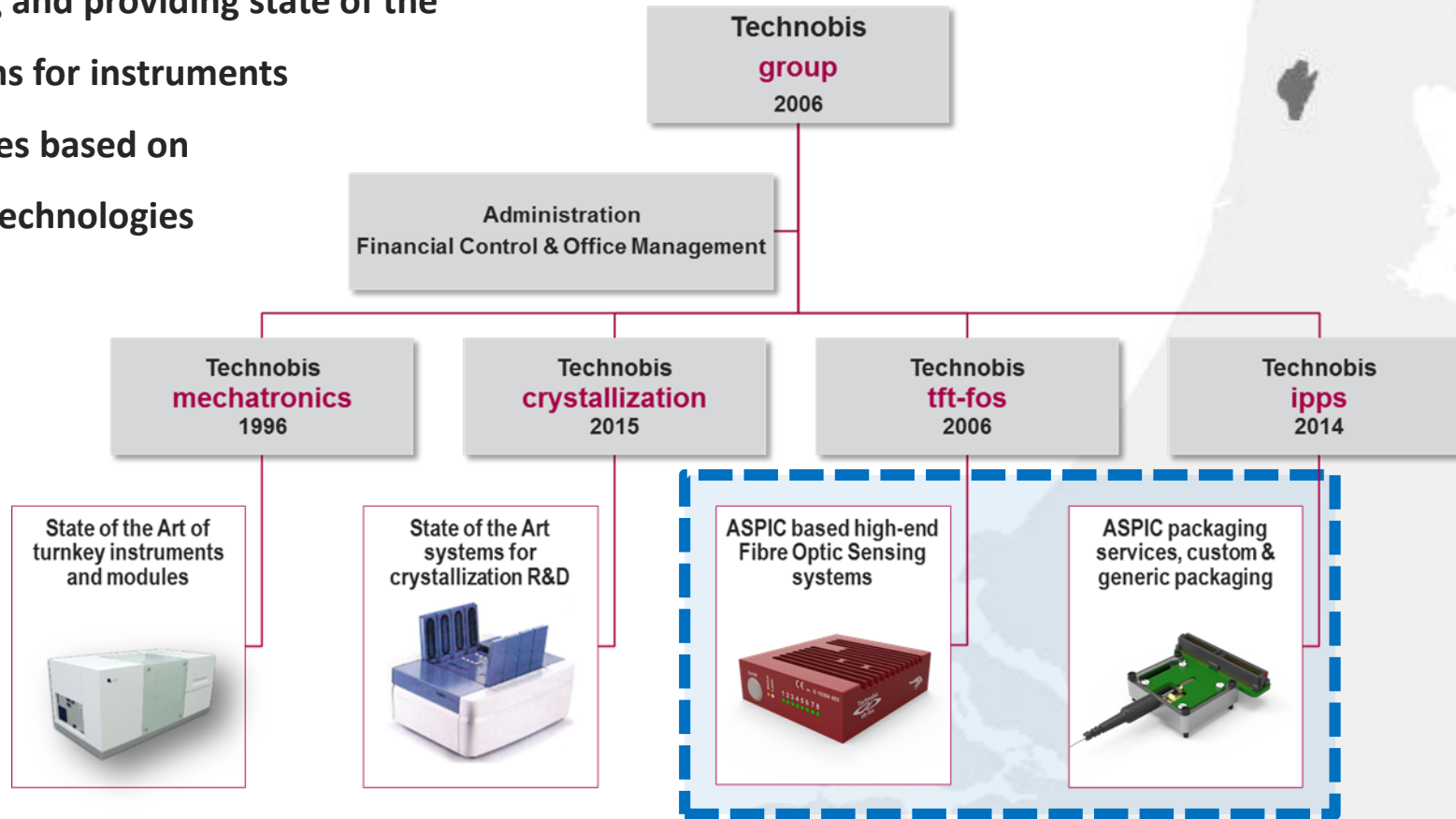
force sensing
shape reconstruction
displacement sensing

GATOR

OpenPICs review meeting 29 august 2017

Technobis

Technobis Introduction

Developing and providing state of the art solutions for instruments and modules based on advanced technologies

Technobis
group
2006

Administration
Financial Control & Office Management

Technobis
mechatronics
1996

Technobis
crystallization
2015

Technobis
tft-fos
2006

Technobis
ipps
2014

State of the Art of turnkey instruments and modules

State of the Art systems for crystallization R&D

ASPIC based high-end Fibre Optic Sensing systems

ASPIC packaging services, custom & generic packaging

Offices & Meeting Rooms (800 m2)
Assembly & testing (700 m2, ESD Compliant)
Conditioned labs for prototyping (128 m2)
Vibration isolated labs (64 m2)
Down-flow lab (28 m2)
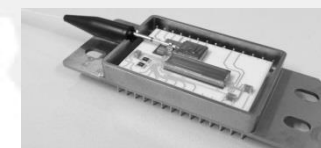
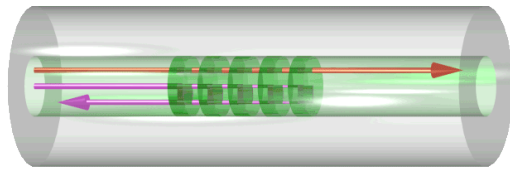**ENGINEERING**   **ASSEMBLY**   **TESTING**   **R&D**   **VALIDATION**   **PACKAGING**   **INTEGRATION**

2

Fibre Optic Sensing Technology

Fibre Bragg Grating

Input spectrum

Transmitted spectrum

Broadband lightsource

Wavelength detection system

Reflected spectrum

λ_1 λ_2 λ_3

a)

Light in →

Modulated light out ←

Intrinsic sensor

Parameter of interest

b)

Light in →

External transducer

Modulated light out ←

Extrinsic sensor

Parameter of interest

Strain

Temperature

Pressure

Shape

Humidity

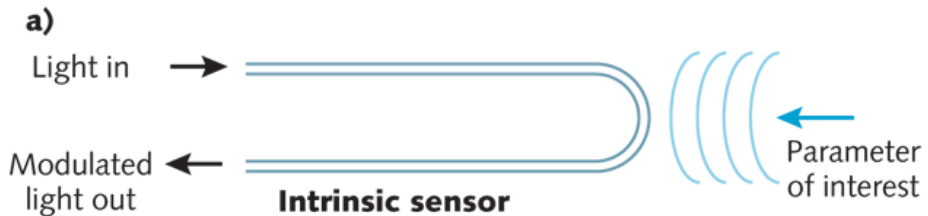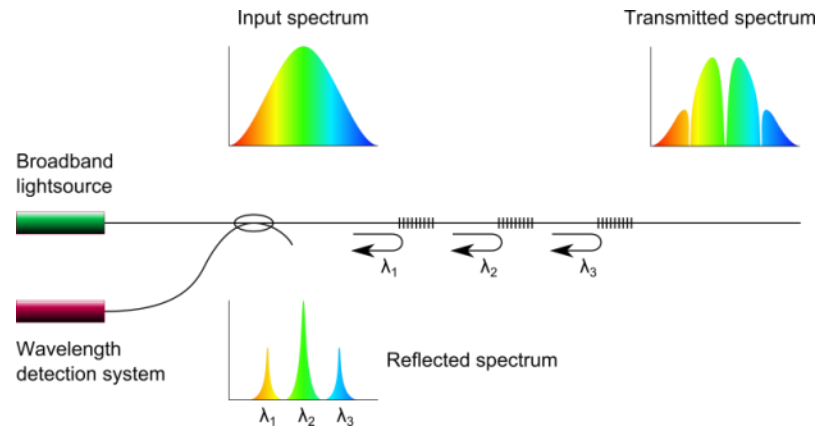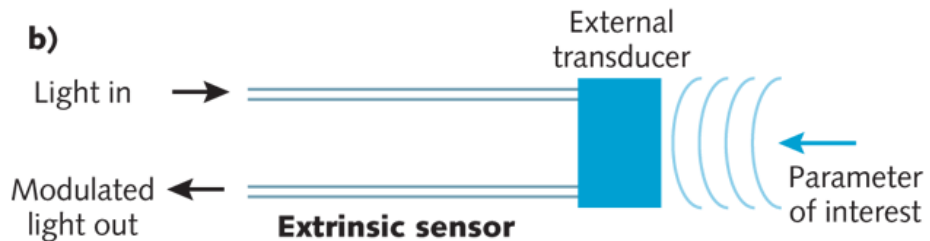**Chemicals**

Why Fibre Optics?

- Totally passive
- Small size & weight
- Chemically inert, intrinsically safe
- Non-conductive, immune to EMI
- Low loss allows remote sensing

High-tech Industry

High resolution strain sensing

Thermal Mapping, Vibration Monitoring,

Position feedback

Aerospace

High reliability strain sensing

Structural & Prognostic Health Monitoring, Shape

Reconstruction, Thermal Sensing, Load Monitoring,

Damage & Impact Detection

Medical

Minimal invasive sensing

Force Sensing, Shape Reconstruction, Pressure &

Temperature Sensing, Haptic Feedback

Energy

High endurance sensing

Strain sensing in high temperature and

radiated environments, Temperature & Heat

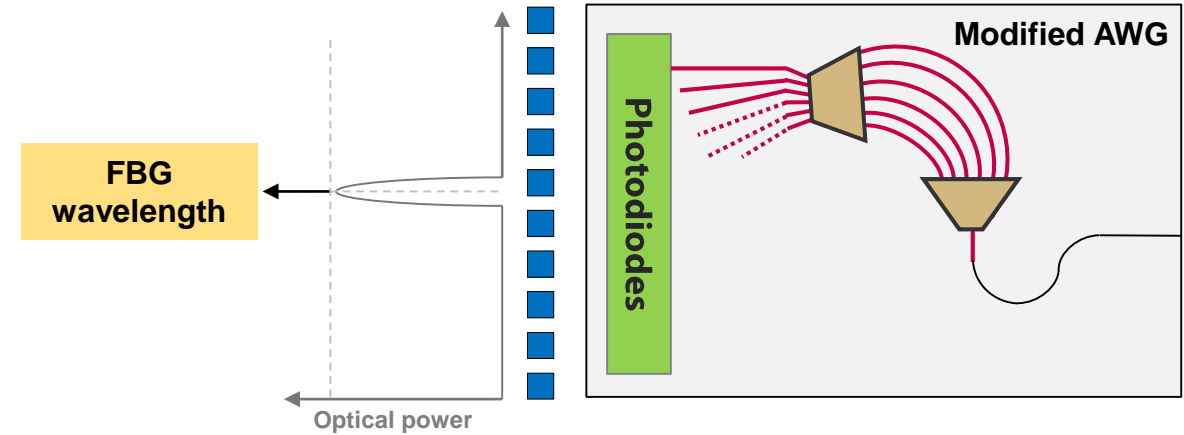Flux Sensing

Technobis
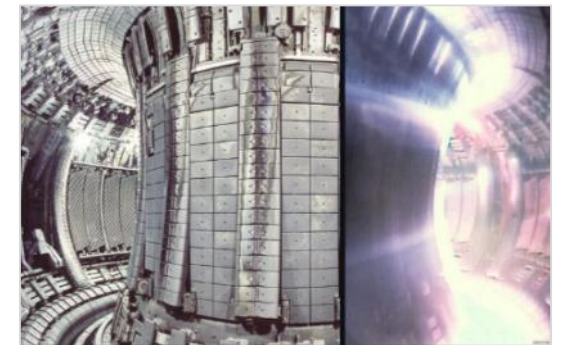
▶ **Interrogation based on a modified AWG**

- Resolution determined by the amount of optical power

- Performance determined by the AWG

▶ **Key parameters**

- Insertion loss (fiber to photodiode)

- AWG profile definition (e.g. shape, side-lobs)

FBG wavelength

Optical power

Photodiodes

Modified AWG

Future additions
SSC: Spot size converter
BIT: Built-In Test
QW: Quantum well (1500-1600 nm)
TC/SI: Top ground contact/Semi-insulating
… etc.

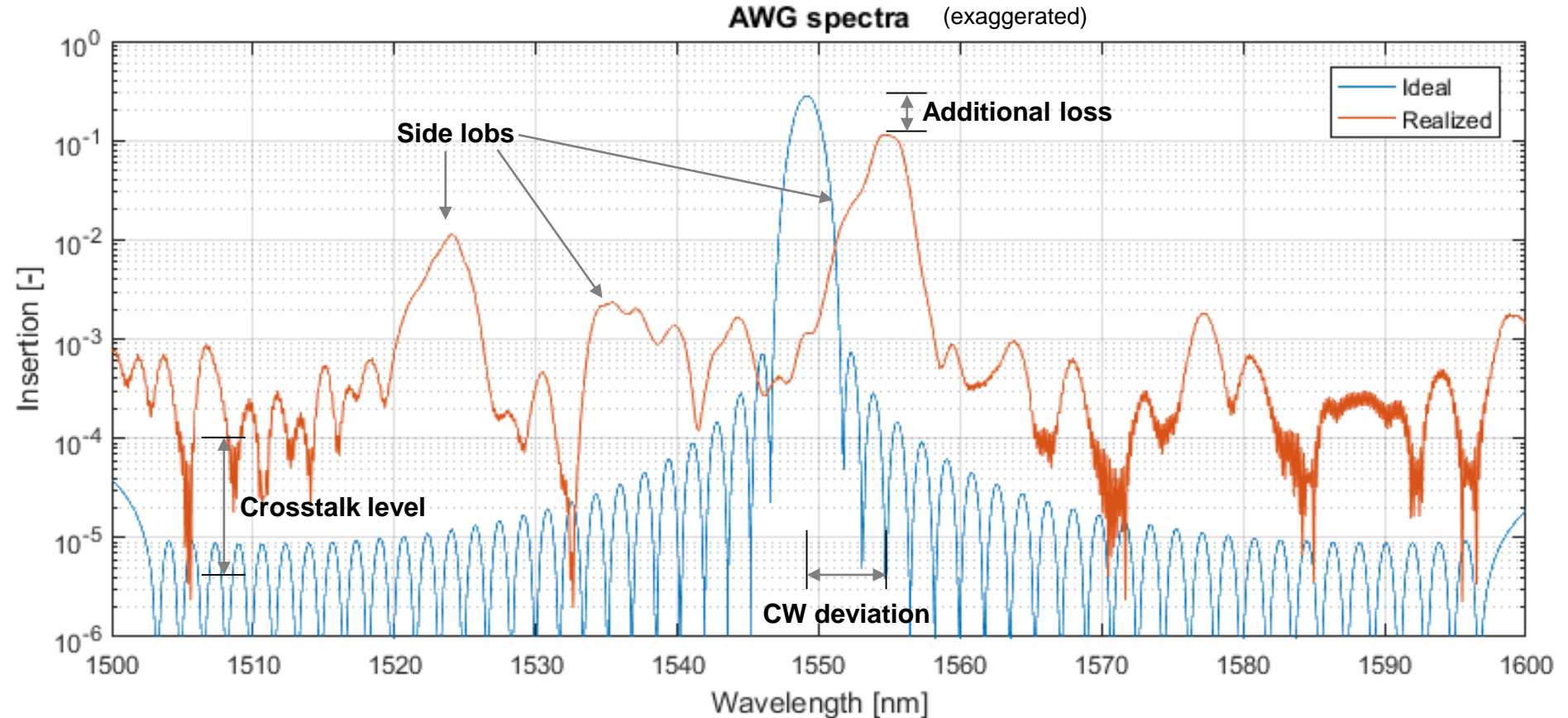Sensing = "analog photonics"

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► **AWG errors**

- From: Waveguide roughness, polarization crosstalk, undesired birefringence, etc.

- Process tolerances!

All have influence on FBG measurement performance!

AWG spectra (exaggerated)

Proposed chip architecture

First goal: improve standard Gator

▶ **Spotsize Converters** (primary)

- Lower insertion loss over 1500-1600 nm

- No polarization dependency

- Improved alignment tolerances

- First straight SSC, later angled SSC!

▶ **High definition lithography** (primary)

- Clean Gaussian AWG profile

- Reduced side-lobs >25 dB

- Polarization dispersion <1 pm

Photodiodes

Well-defined modified AWG

SSC

Low-loss waveguides
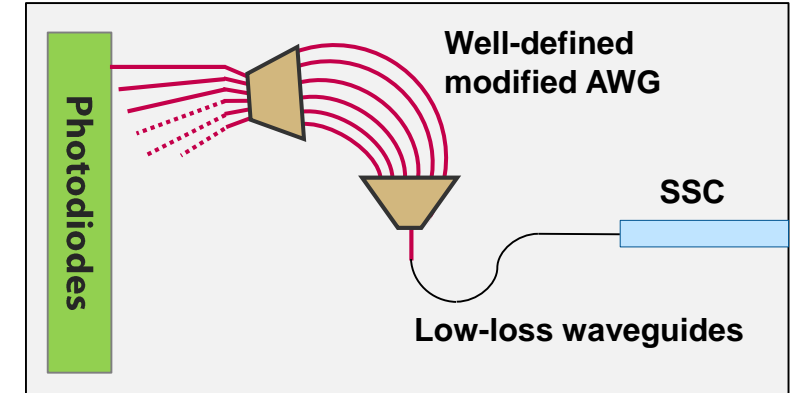
▶ **Low loss waveguides**

▶ **High responsive photodiodes**

- Low noise / high shunt-resistance

- High QE for 1500-1600 nm (> 0.9 A/W)

➔ Next generations will also include light sources, etc…

First application:

- < 1 MHz linewidth

- Tunable

MoSCoW:
- Must have (at least)
- Should have
- Could have (nice-to-have)
- Won't have (for now)

For SENSING APPLICATION 1 (LDG // PLG)					23-10-2017
Specification	Priority	Requirement			unit
		Min.	nominal	max	
Central wavelength (default)	Must	1535	1550	1565	nm
Modulation range (peak peak)	Must	1	10		pm
	Should		1500		pm
	Could		10	50	nm
Modulation frequency (with nominal peak peak)	Must	10	100		Hz
	Should	1.000	10.000		Hz
	Could		1		MHz
Tuning range	Must	1	2		nm
	Should	5	10		nm
	Could		50	100	nm
Tuning speed	Must	10			pm/sec
	Should		1		nm/sec
	Could		10		nm/sec
Linewidth	Must		100	900	kHz
	Should		40		kHz
	Could		1		kHz
Output power	Must	1			mW
	Should		10		mW
	Could		50		mW

▶ **Second application**

- Narrow linewidth < 50 kHz

- Not so tunable

MoSCoW:
- Must have (at least)
- Should have
- Could have (nice-to-have)
- Won't have (for now)

For SENSING APPLICATION 2 (CRT // PLG)					23-10-2017
Specification	Priority	Requirement			unit
		Min.	nominal	max	
Central wavelength (default)	Must	1535	1550	1565	nm
Modulation range (peak peak)	Must	0	1		pm
	Should		100		pm
	Could		1.5	50	nm
Modulation frequency (with nominal peak peak)	Must	1	100		Hz
	Should	1.000	10.000		Hz
	Could		1		MHz
Tuning range	Must	1	2		nm
	Should	5	10		nm
	Could		50	100	nm
Tuning speed	Must	10			pm/sec
	Should		1		nm/sec
	Could		10		nm/sec
Linewidth	Must		10	40	kHz
	Should		1	20	kHz
	Could		1		kHz
Output power	Must	1			mW
	Should		10		mW
	Could		50		mW

▶ **Primary goal for improved building blocks:**

- Lower insertion loss

- Better waveguide definitions

Technobis

Mission/Strategy

**Chip
Volume
Packaging**

**Application
Specific
Qualification**

Roadmap

**Flight Test
Civil Aircraft**

Successful !!

**Flight Test
Helicopter**

- 2016
  - ◄ OEM Qualification
  - ◄ Packaging Capability 1.000
  - ◄ Medical Qualification
- 2017
  - ◄ Packaging Capability 10.000
- 2018
  - ◄ Aerospace Qualification
  - ◄ Packaging Capability 50.000
- 2019
  - ◄ Packaging Capability 200.000
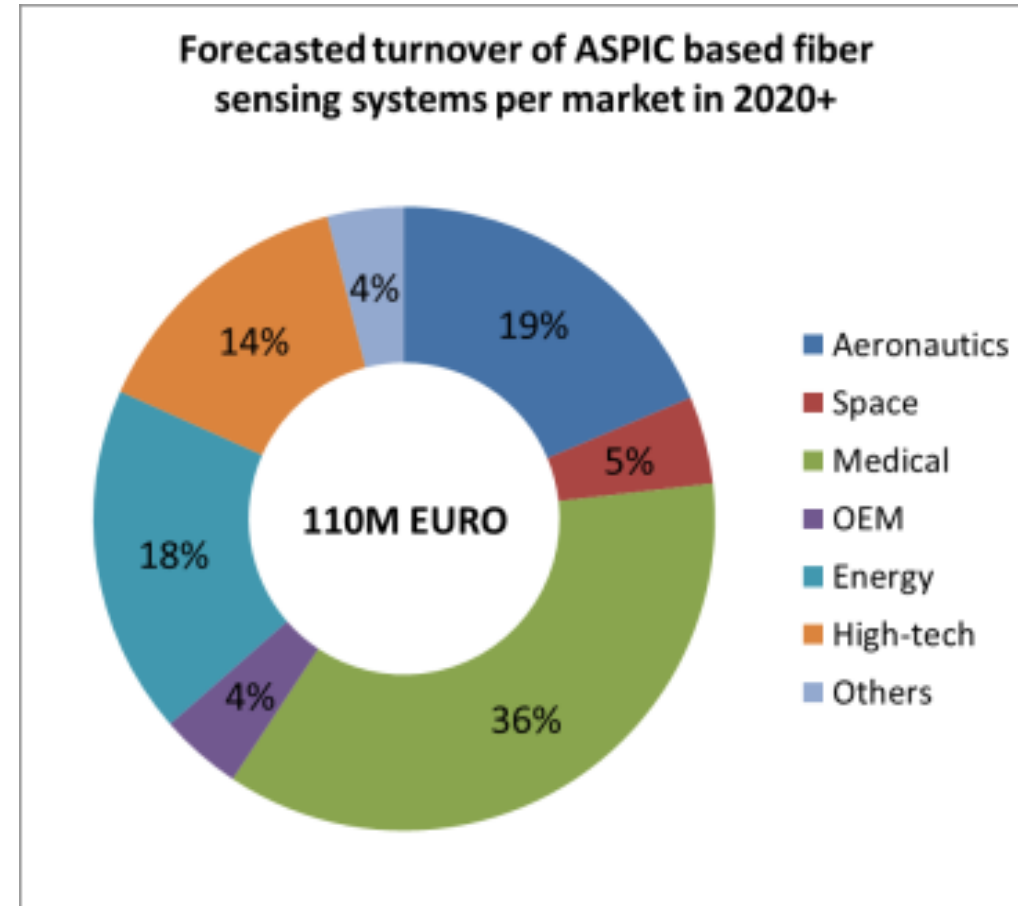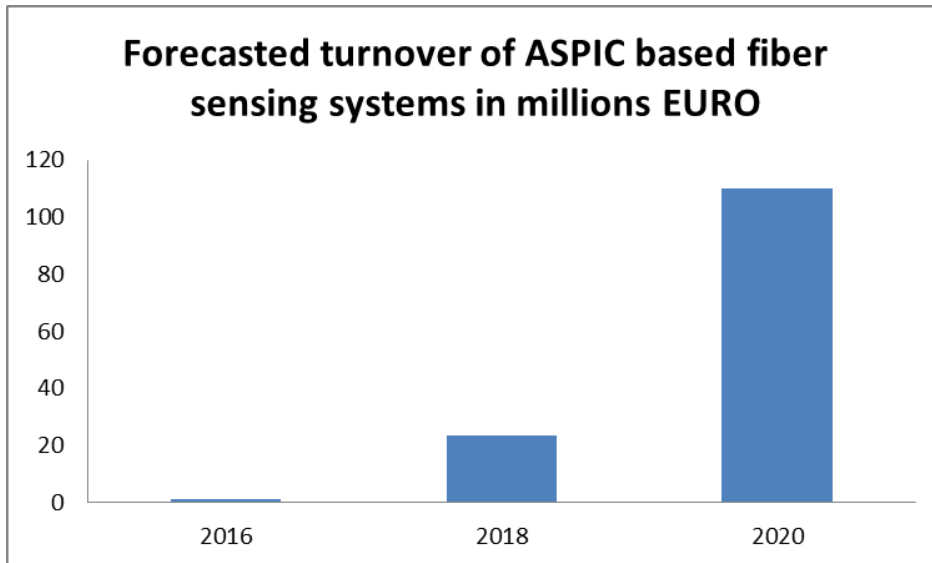- 2020
  - ◄ Space Qualification

Development

☐ Market Focus
- ☐ Aeronautics
- ☐ High-Tech
- ☐ Medical
- ☐ Energy

☐ Application Focus
- ☐ Multi-point Sensing
- ☐ Distributed FBG Sensing
- ☐ Thermal Mapping
- ☐ Shape Sensing
- ☐ Damage & Impact Detection
- ☐ Smart Structure Concepts

☐ Technology Focus
- ☐ High Performance (FBG) sensing
- ☐ Cross-sensitivity Strain /Temperature
- ☐ and more

▶ **Most significant markets for Technobis:**

- Medical
- Aeronautics
- Energy
- High-Tech

Forecasted turnover of ASPIC based fiber sensing systems in millions EURO

Forecasted turnover of ASPIC based fiber sensing systems per market in 2020+

110M EURO

- Aeronautics — 19%
- Space — 5%
- Medical — 36%
- OEM — 4%
- Energy — 18%
- High-tech — 14%
- Others — 4%

Thank you for your attention

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www.technobis.com